NASA's Centennial Challenges Program

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Program Manager

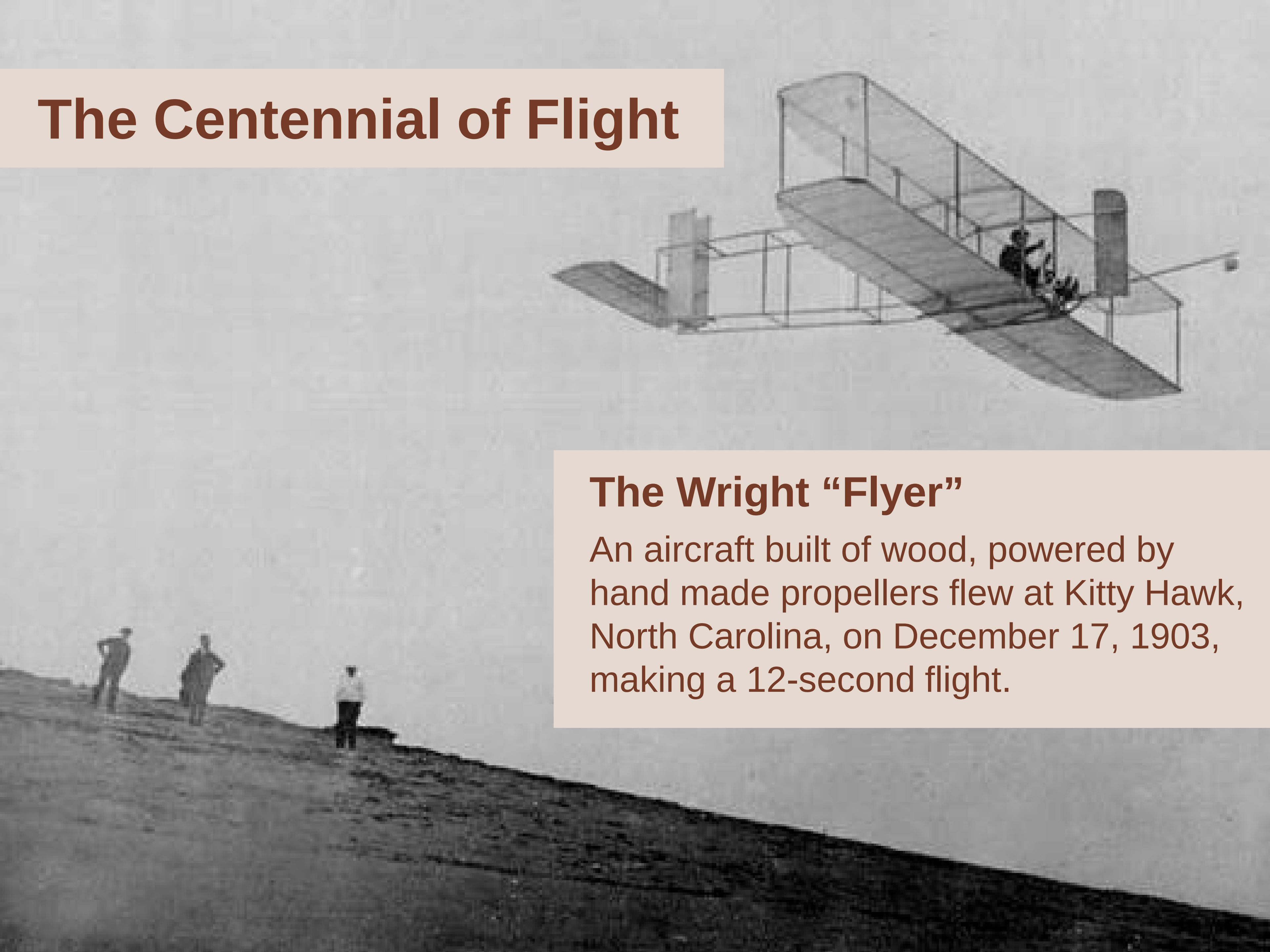
www.nasa.gov/**winit**

Why Centennial Challenges?

- The program was established to conduct prize competitions in support of the Vision for Space Exploration and ongoing NASA programs

- Although the first competition was started in 2005, development of the program started in 2003 to commemorate …

The Centennial of Flight



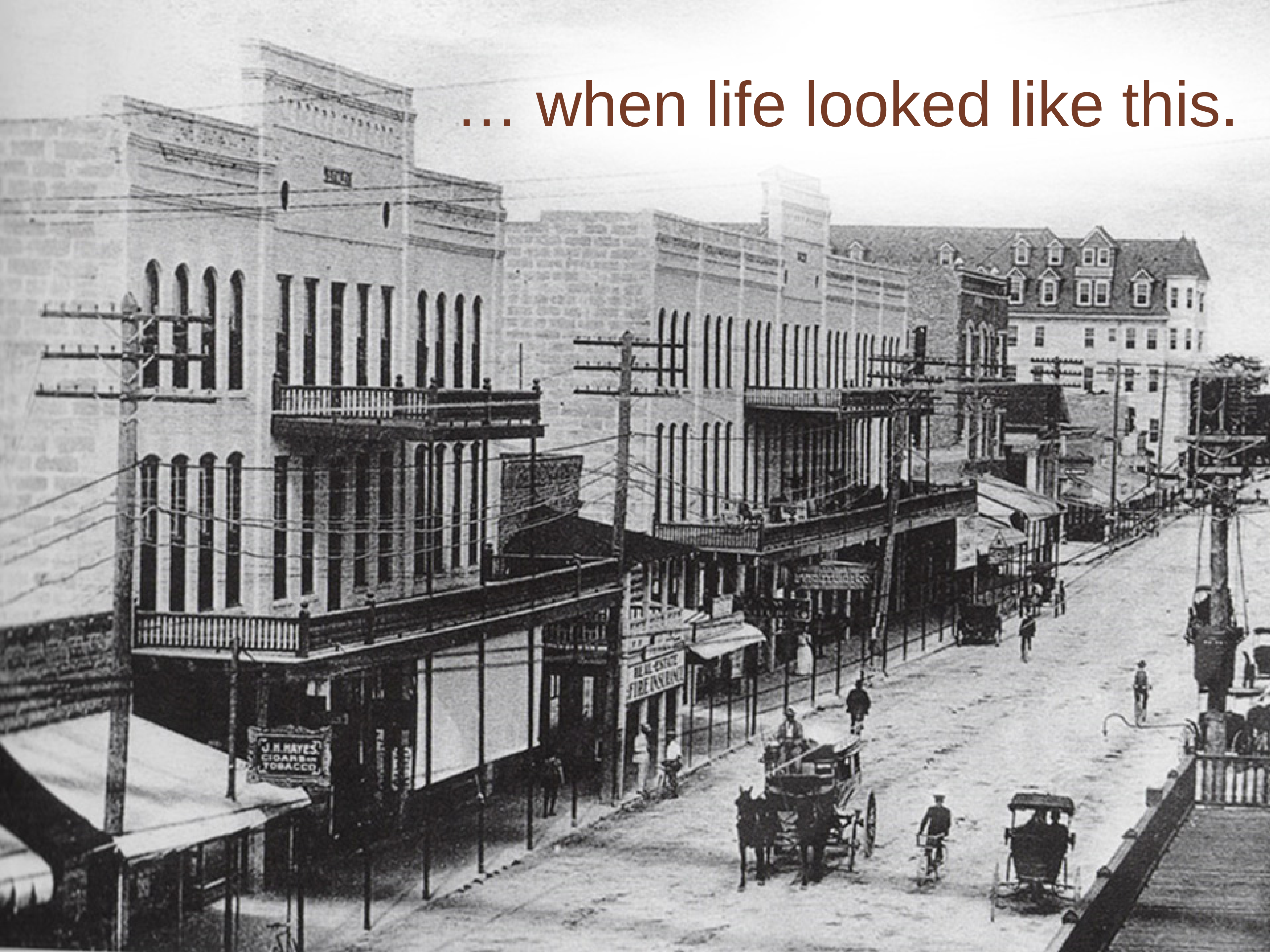
The Wright "Flyer"

An aircraft built of wood, powered by hand made propellers flew at Kitty Hawk, North Carolina, on December 17, 1903, making a 12-second flight.

In the early 1900s, brothers and bicycle builders Wilbur and Orville Wright revolutionized the world with the first successful airplane.


At the turn of the century, it was probably hard to imagine this …

… when life looked like this.



They weren’t experts. **How did they do it?**

They used what they knew: **Bicycles**

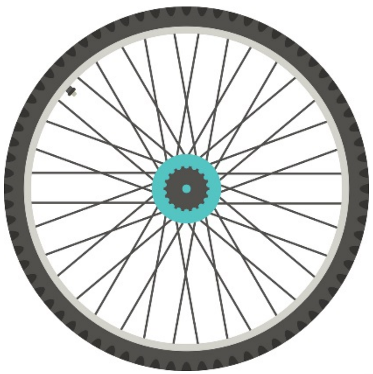
• Balance and control.

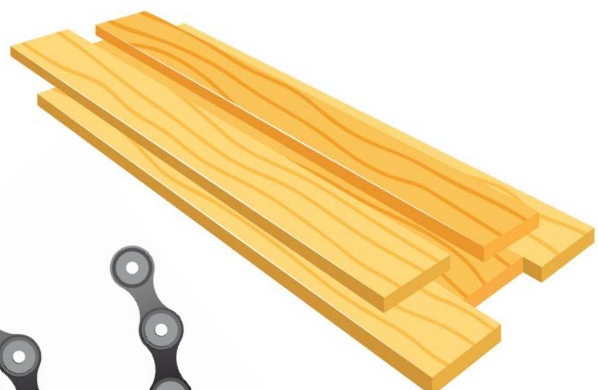
• Strong but lightweight structures.

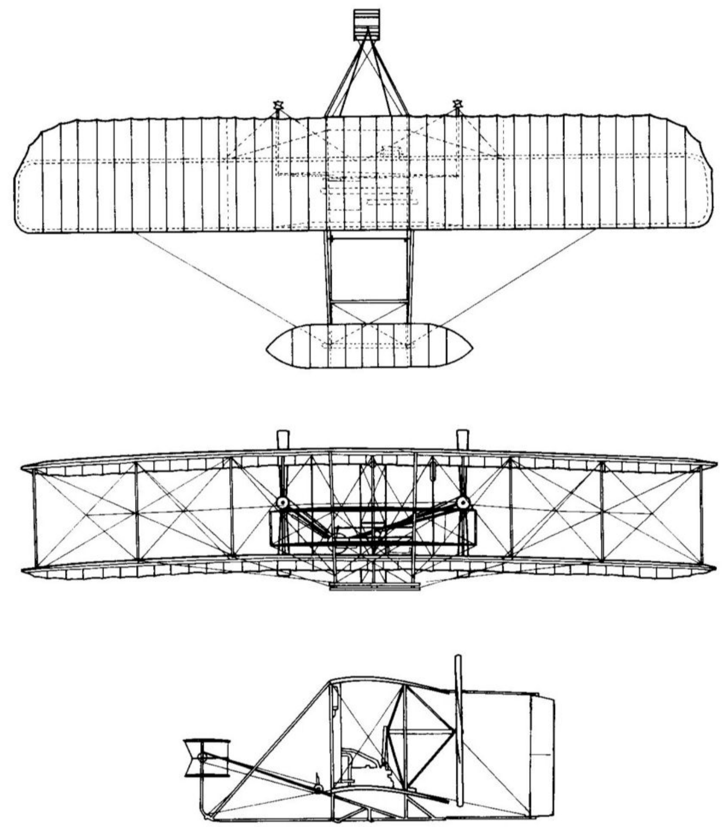
• Chain-and-sprocket transmission system for propulsion.

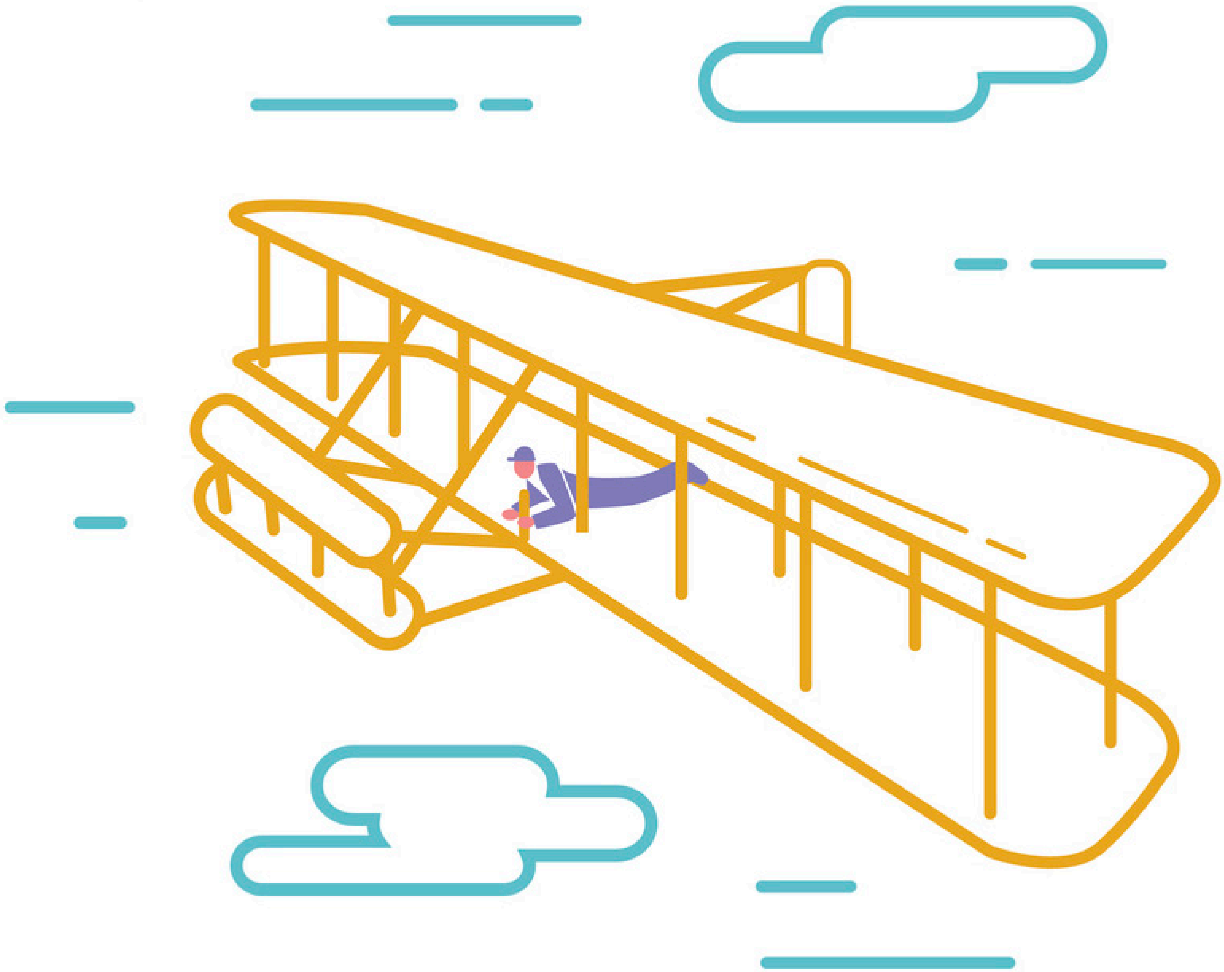
• Wind resistance and the aerodynamic shape of the operator.

For less than $1,000, they used what they had to construct the aircraft.









All successful airplanes since have incorporated the basic design elements of the 1903 Wright Flyer.

"If we worked on the assumption that what is accepted as true really is true, then there would be little hope for advance."

- Orville Wright


centennialchallenges

Why Centennial Challenges Works

Agency Technology Needs

Centennial Challenges

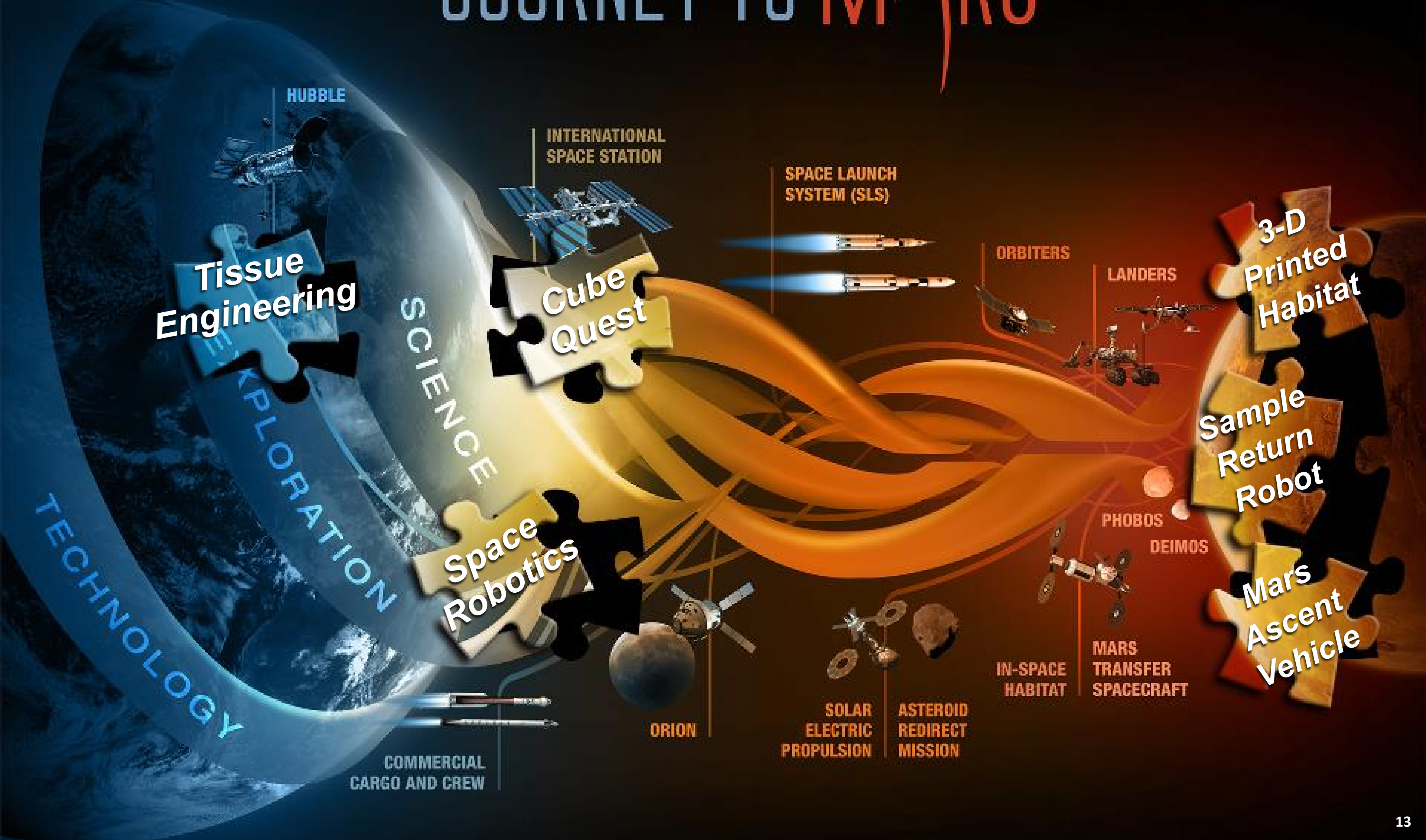
Pays only for success
Allows for multiple solution paths. Encourages innovation
Involves the public.

Grants, Contracts, In-House

Pay up front, for a single solution.

centennial**challenges...**

...A Piece of Our JOURNEY TO MARS



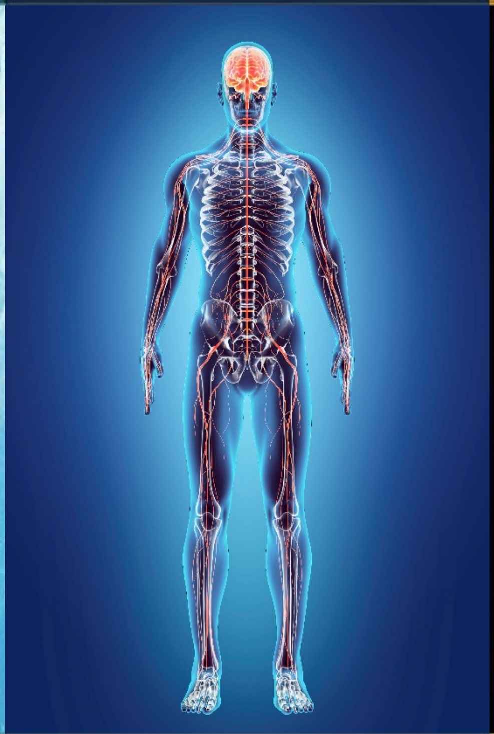
Cube Quest

Innovation in Small Spacecraft Propulsion + Communications

Objective: Design, build, and deliver flight-qualified, small satellites (CubeSats) capable of advanced operations near and beyond the moon.

Vascular Tissue

Growth of Vascularized Major Organ Tissues



Objective: Produce viable thick-tissue assays that can be used to advance research on earth, the ISS National Laboratory and Deep Space.

Space Robotics

Improve Humanoids Autonomous Perception + Manipulation

Objective: Advance robotic software that increases the autonomy of dexterous humanoid robots on Mars and beyond.

3D-Printed Habitat

Autonomous, Sustainable Additive Manufacturing of Habitats

Objective: Advance additive construction technology needed to create sustainable housing solutions for Earth and beyond.


What if a long-distance call could reach a new world?
www.nasa.gov/cubequest
CUBE QUEST CHALLENGE

WHY A CUBE QUEST CHALLENGE?

- **To date, CubeSats haven’t ventured beyond LEO**
  - **Limited communication range**
  - **Limited communication data rate**
  - **Lack of radiation tolerance**
  - **Lack in-space propulsion technologies**
  - **Depend on Earth-based navigation reference**

- **Can CubeSats enable more affordable science and exploration missions in Deep Space?**


What if space held the key to better health?
www.nasa.gov/vtchallenge
VASCULAR TISSUE CHALLENGE

WHY A VASULARIZATION CHALLENGE?

- **Vascularization is one of the great challenges that tissue engineering faces in order to achieve sizeable tissue and organ substitutes that contain living cells.**

- **Tissue or organ substitutes in which any dimension, such as thickness, exceeds 400 μm needs to be vascularized to ensure cellular survival.**

- **Advancing the Technology Could:**
  - **Enable and accelerate studies of the effects of space radiation exposure, cancer biology and drug efficacy on human cells in space**
  - **Support the study of regeneration and repair of human tissues**
  - **Encourages commercial interest**


NASA
What if your coworkers came with batteries?
SPACE ROBOTICS CHALLENGE
www.nasa.gov/spacebot

- **Existing humanoid robots …**
  - Are not advanced enough for time-delayed operations
  - Use hydraulic systems that cannot be used in space environments
  - Require advancement in dexterity

- **Humanoids could…**
  - Remote operate in dangerous environments from the comfort of home
  - Assist in Deep Space exploration
  - Set up space exploration habitat infrastructure


What will home look like ...
on Mars?
www.nasa.gov/3DPHab
3D-PRINTED HABITAT CHALLENGE

WHY A 3D-PRINTED HABITAT CHALLENGE?

- **Existing 3D-Printing Technology…**
  - Is advanced mostly for small plastic items
  - Require advancements for recycled & in-situ material

- **Advanced 3D-Printing Technology for Mars Construction**
  - Needs larger systems for habitat printing
  - Requires binders for construction using Mars regolith and recycled material
  - Requires advancements in material composition technology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